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TI    Soldered article having electric conductive parts
IN    Takaoka, Hidekiyo; Maekawa, Kiyotaka
PA    Murata Mfg. Co., Ltd., Japan
SO    Jpn. Kokai Tokkyo Koho, 6 pp.
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PI    JP 11216591          A2    19990810    JP 1998-16142           19980128
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PRAI  JP 1998-16142        A3    19980128
AB    The article comprises an elec. conductive transition metal parts which is
      soldered by Sn alloy solder containing (A) ≥1 selected from
      Co 0.01-1, Fe 0.01-0.2, Mn 0.01-0.2, Cr 0.01-0.2, and Pd 0.01-2
      weight%, and (B) ≥1 selected from Ag 0.5-9,  Cu 0.5-2, and Sb
      0.5-5 weight%.  The conductive pars may be Cu, Ag, Ni, Au, Pd, Pt,
      Zn, of their alloy.  The solder composition inhibits diffusion of the
conductor
      into the molten solder.
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PATENT ABSTRACTS OF JAPAN

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(54) SOLDERING PRODUCT

(57)Abstract:
PROBLEM TO BE SOLVED: To prevent the electrode consuming and characteristic deterioration when soldering or thermal aging after soldering is carried out.
SOLUTION: A part having a transition metal conductor, which is easy to be dispersed, is jointed to molten Sn by the solder to form a soldering product. The solder contains at least one kind of 0.01-1 wt.% Co, 0.01-0.2 wt.% Fe, 0.01-0.2 wt.% Mn, 0.01-0.2 wt.% Cr, 0.01-2 wt.% Pd, at least one kind of 0.5-9 wt.% Ag, 0.5-2 wt.% Cu, 0.5-5 wt.% Sb, and the balance of Sn.

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CLAIMS

[Claim(s)]

[Claim 1] They are the soldering goods which come to join the components which have the transition metallic conductor which is easy to diffuse to fused Sn with solder. The presentation of said solder At least one kind of 0.01 - 1 % of the weight of Co(es), 0.01 - 0.2 % of the weight of Fe(s), 0.01 - 0.2 % of the weight of Mn, 0.01 - 0.2 % of the weight of Cr(s), and 0.01 - 2 % of the weight of Pd, 0.5 - 9 % of the weight of Ag, 0.5 - 2 % of the weight of Cu(s), soldering goods characterized by coming to contain at least one kind and the remaining Sn among 0.5 - 5 % of the weight of Sb(s).

[Claim 2] Said transition metallic conductors are soldering goods according to claim 1 characterized by using at least one kind in the simple substances of Cu, Ag, nickel, Au, Pd, Pt, and Zn, or those alloys.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to soldering goods.
[0002]
[Description of the Prior Art] Before, solder is used in order to obtain electric and mechanical connection of electronic equipment and electronic parts. The solder (it considers as Pb free solder hereafter.) with which this solder uses as a principal component Sn which does not contain Pb in consideration of earth environment although what used Sn and Pb as the principal component (it considers as Sn-Pb system solder below.) has generally been used, and the remainder consists of Ag, Bi, Cu, In, Sb, etc. is used increasingly.
[0003] By using this Pb free solder in recent years, the soldering goods with which soldering nature has a good electric joint have been manufactured.
[0004]
[Problem(s) to be Solved by the Invention] However, in the soldering goods using the solder whose Sn is a principal component, especially Pb free solder, when electrode ****** happened at the time of soldering or elevated-temperature neglect and heat aging were performed, there was a trouble by diffusion of Sn that degradation of electric and a mechanical property took place.
[0005] The purpose of this invention is to offer the soldering goods which neither electrode ****** nor property degradation can produce easily, when the time of soldering or soldering post heating aging is performed.
[0006]
[Means for Solving the Problem] This invention came to complete soldering goods, in order to solve the above-mentioned technical problem. The soldering goods of invention of this application 1st are soldering goods which come to join the components which have the transition metallic conductor which is easy to diffuse to fused Sn with solder. The presentation of said solder At least one kind of 0.01 - 1 % of the weight of Co(es), 0.01 - 0.2 % of the weight of Fe(s), 0.01 - 0.2 % of the weight of Mn, 0.01 - 0.2 % of the weight of Cr(s), and 0.01 - 2 % of the weight of Pd, It is characterized by coming to contain at least one kind and the remaining Sn among 0.5 - 9 % of the weight of Ag, 0.5 - 2 % of the weight of Cu(s), and 0.5 - 5 % of the weight of Sb(s).
[0007] moreover, the soldering goods of invention of this application 2nd -- setting -- said transition metals -- a conductor is characterized by using at least one kind in the simple substances of Cu, Ag, nickel, Au, Pd, Pt, and Zn, or those alloys.
[0008]
[Embodiment of the Invention] The gestalt of operation of this invention is explained below. The soldering goods of this invention are soldering goods which come to join the components which have the transition metallic conductor which is easy to diffuse to fused Sn with solder. The presentation of solder At least one kind of 0.01 - 1 % of the weight of Co(es), 0.01 - 0.2 % of the weight of Fe(s), 0.01 - 0.2 % of the weight of Mn, 0.01 - 0.2 % of the weight of Cr(s), and 0.01 - 2 % of the weight of Pd, It is the presentation which contains at least one kind and the remaining Sn among 0.5 - 9 % of the weight of Ag, 0.5 - 2 % of the weight of Cu(s), and 0.5 - 5 % of the weight of Sb(s). Such a presentation enables it to offer the soldering goods which have sufficient electrode-proof ********, while soldering nature and bonding strength are good.
[0009] That is, it is for Co, Fe, Mn, Cr, and Pd by which slight amount addition was carried out to form a segregation layer in the junction interface of a conductor and solder, to prevent diffusion into the melting solder of a conductor, and to prevent electrode ******.

[0010] The addition of Above Co was made into 0.01 - 1 % of the weight in 100 % of the weight of whole because electrode-proof ******** deteriorated when the addition of Co is less than 0.01 % of the weight. It is because liquidus-line temperature rises and a melting property is checked on the other hand, when the addition of Co exceeds 1 % of the weight. In addition, more desirable Co addition is 0.01 - 0.5% of the weight of the range, and its time of especially Co addition being 0.5 % of the weight is desirable.

[0011] The addition of Above Fe was made into 0.01 - 0.2 % of the weight in 100 % of the weight of whole because electrode-proof ******** deteriorated when the addition of Fe is less than 0.01 % of the weight. It is because liquidus-line temperature rises and a melting property is checked on the other hand, when the addition of Fe exceeds 0.2 % of the weight. In addition, more desirable Fe addition is 0.01 - 0.1% of the weight of the range, and its time of especially Fe addition being 0.1 % of the weight is desirable.

[0012] The addition of Above Mn was made into 0.01 - 0.2 % of the weight in 100 % of the weight of whole because electrode-proof ******** deteriorated when the addition of Mn is less than 0.01 % of the weight. It is because liquidus-line temperature rises and a melting property is checked on the other hand, when the addition of Mn exceeds 0.2 % of the weight. In addition, more desirable Mn addition is 0.01 - 0.1% of the weight of the range, and its time of especially Mn addition being 0.1 % of the weight is desirable.

[0013] The addition of Above Cr was made into 0.01 - 0.2 % of the weight in 100 % of the weight of whole weight because electrode-proof ******** deteriorated when the addition of Cr is less than 0.01 % of the weight. It is because liquidus-line temperature rises and a melting property is checked on the other hand, when the addition of Cr exceeds 0.2 % of the weight. In addition, more desirable Cr addition is 0.01 - 0.1% of the weight of the range, and its time of especially Cr addition being 0.1 % of the weight is desirable.

[0014] The addition of Above Pd was made into 0.01 - 2 % of the weight in 100 % of the weight of whole weight because electrode-proof ******** deteriorated when the addition of Pd is less than 0.01 % of the weight. It is because liquidus-line temperature rises and a melting property is checked on the other hand, when the addition of Pd exceeds 2 % of the weight. In addition, more desirable Pd addition is 0.01 - 1% of the weight of the range, and its time of especially Pd addition being 0.5 % of the weight is desirable.

[0015] The addition of Above Ag was carried out among [0.5-9] 100 % of the weight of whole weight because the improvement effect on the strength was small when the addition of Ag is less than 0.5 % of the weight. It is because the bonding strength fall by a superfluous Ag3Sn intermetallic compound depositing when the addition of Ag exceeds 9 % of the weight, and the melting property by solder liquidus-line temperature rising are checked on the other hand.

[0016] When the addition of Cu was less than 0.5 % of the weight, the addition of Above Cu was made into 0.5 - 2 % of the weight in 100 % of the weight of whole weight because the improvement effect on the strength was small. It is because the bonding strength fall by superfluous Cu6Sn5 and a Cu3Sn intermetallic compound depositing when the addition of Cu exceeds 2 % of the weight, and the melting property by solder liquidus-line temperature rising are checked on the other hand.

[0017] When the addition of Sb was less than 0.5 % of the weight, the addition of Above Sb was made into 0.5 - 12 % of the weight in 100 % of the weight of whole weight because the improvement effect on the strength was small. On the other hand, when the addition of Sb exceeds 12 % of the weight, it is because thermal shock nature and workability are checked when elongation falls.

[0018] As a presentation of the transition metallic conductor which is easy to diffuse to fused Sn as used in the field of this invention, the simple substance of Cu, Ag, nickel, Au, Pd, Pt, and Zn etc. is typical. In addition, the alloy of these transition metals, for example, Ag/Pd, Ag/Pt, etc. are sufficient. They are the simple substance of Cu, Ag, and nickel, or its alloy more preferably. Even if it uses for the goods which have such a conductor that is easy to carry out electrode ******, electrode ****** control is attained maintaining soldering nature and bonding strength.

[0019] Although a glass frit and various additives (metallic oxide etc.) are added by the above-mentioned transition metallic conductor if needed, if the metal presentations which are electric conduction components are the above presentations, of course, the same effectiveness is acquired. Moreover, the same effectiveness is acquired, also when low melting point metals, such as Bi and In, are added as a solder presentation in order to lower working temperature.

[0020] Here, in this invention, an unescapable impurity may be included as a solder presentation in addition to the above-mentioned component. The element mixed as an unescapable impurity when manufacturing solder or the element containing from the first, for example, Pb, Bi, Cu, Na, etc., is mentioned.

[0021] After the soldering goods of this invention process the solder made to dissolve the above-mentioned addition component in Sn of a principal component in the shape of a ball, carry a solder ball on components or a substrate and apply flux, they can be easily created by heating to temperature predetermined in the inside of atmospheric air, and joining the conductor of components.
[0022] In addition, although generally soldered in N2 ambient atmosphere in many cases a sake [on a soldering disposition], it is possible to solder in atmospheric air in this invention, since there are few additions of Co, Fe, Mn, Cr, and Pd.
[0023] the components itself to which the soldering goods of this invention are joined, and the conductor of components, although the whole including the soldered joint section which joined comrades electrically and mechanically is meant and there are various gestalten For example, electric in the conductor formed in the element-placement substrate, and the conductor formed in components The thing made to solder in order to make it connect mechanically, the thing which carried out the solder price in order to connect an electronic-parts component and a terminal electrically and mechanically, the thing made to solder in order to connect the electrodes of an electronic-parts component electrically and mechanically are typical.
[0024] As the above-mentioned element-placement substrate, ceramic substrates, such as a printed circuit board made from glass epoxy, a printed circuit board made from a phenol, and an alumina, the substrate which has insulator layers, such as a ceramic, on a metaled front face are mentioned, for example. furthermore, the above -- as a conductor, wiring circuits, such as a printed circuit board, the terminal electrode of electronic parts, a lead terminal, etc. are mentioned.
[0025] Thus, the soldering goods of produced this invention have soldering nature and good bonding strength, and since they have outstanding electrode-proof ********, can set up soldering temperature freely and become the thing excellent in workability. Moreover, it becomes possible to lessen the addition of expensive electrode ****** control elements, such as Ag. Next, although this invention is explained still more concretely based on an example, this invention is not limited only to this example.
[0026]
[Example 1] The solder presentation used by this example is shown in Table 1. In addition, the presentation of the example of a comparison is also collectively shown in Table 1.
[0027]
[Table 1]

[重量%]

	Sn	Pb	Co	Fe	Mn	Cr	Pd	Ag	Cu	Sb
実施例1	94.99		0.01							5.0
実施例2	94.5		0.5							5.0
実施例3	94.0		1.0							5.0
実施例4	94.49			0.01						5.0
実施例5	94.9			0.1						5.0
実施例6	94.8			0.2						5.0
実施例7	94.49				0.01					5.0
実施例8	94.9				0.1					5.0
実施例9	94.8				0.2					5.0
実施例10	94.49					0.01				5.0
実施例11	94.9					0.1				5.0
実施例12	94.8					0.2				5.0
実施例13	94.99						0.01			5.0
実施例14	94.5						0.5			5.0
実施例15	94.0						1.0			5.0
実施例16	93.0						2.0			5.0
実施例17	99.0						0.5			0.5
実施例18	87.5						0.5			12.0
実施例19	96.0		0.5					3.5		
実施例20	96.4			0.1				3.5		
実施例21	96.4				0.1			3.5		
実施例22	96.4					0.1		3.5		
実施例23	99.0						0.5	0.5		
実施例24	96.0						0.5	3.5		
実施例25	90.5						0.5	9.0		
実施例26	98.8		0.5						0.7	
実施例27	99.2			0.1					0.7	
実施例28	99.2				0.1				0.7	
実施例29	99.2					0.1			0.7	
実施例30	98.8						0.5		0.7	
実施例31	99.0						0.5		0.5	
実施例32	97.5						0.5		2.0	
比較例1	95.0									5.0
比較例2	96.5							3.5		
比較例3	99.3								0.7	

[0028] About the solder furthermore shown in Table 1, the evaluation result of electrode-proof ******** at the time of soldering and soldering nature is shown in Table 2.

[0029]

[Table 2]

	半田付け後の電極面積残存率[%]		半田広がり率 [%]	評価温度 [℃]
	Cu電極	Ag電極		
実施例1	85.0	50.0	70	280
実施例2	98.0	60.0	71	280
実施例3	99.6	61.2	65	280
実施例4	77.0	38.0	70	280
実施例5	80.0	40.2	69	280
実施例6	81.0	41.0	63	280
実施例7	99.0	74.2	70	280
実施例8	99.5	80.1	66	280
実施例9	99.4	79.2	60	280
実施例10	86.0	60.2	70	280
実施例11	98.4	63.0	67	280
実施例12	99.0	65.3	62	280
実施例13	82.1	51.6	71	280
実施例14	95.4	63.5	70	280
実施例15	96.3	65.4	69	280
実施例16	97.1	67.8	63	280
実施例17	95.9	53.4	72	280
実施例18	84.1	51.8	78	300
実施例19	99.0	81.0	72	250
実施例20	95.4	76.8	69	250
実施例21	99.2	89.7	64	250
実施例22	99.2	85.0	66	250
実施例23	88.7	79.3	72	260
実施例24	99.7	84.6	72	250
実施例25	99.5	88.1	81	330
実施例26	99.7	52.0	71	260
実施例27	97.0	40.8	69	260
実施例28	99.5	68.9	65	260
実施例29	99.8	58.4	66	260
実施例30	99.6	53.2	72	260
実施例31	99.2	52.3	72	260
実施例32	99.5	50.1	78	330
比較例1	89.2	31.7	72	250
比較例2	7.0	0.0	70	280
比較例3	92.5	0.0	71	260

[0030] Here, the electrode-proof ******** evaluation at the time of soldering measured by the electrostatic-capacity changing method. the veneer capacitor which carried out printing baking of Cu electrode (3 micrometers of thickness), or the Ag electrode (20 micrometers of thickness) -- solder -- being immersed -- the difference of the electrostatic capacity before and behind immersion -- said difference [as opposed to / take a value and / the electrostatic capacity before immersion] -- the survival rate of an electrode was computed in quest of the value. The soldering temperature which evaluated is shown in Table 2. For 10 seconds, since the capacity change after immersion and Ag electrode were easy to be consumed, Cu electrode measured the capacity change after immersion for 3 seconds.

[0031] In any case, in Cu electrode, effectiveness was [the alloying element of this invention] in electrode foods crack control as compared with the example of a comparison. An electrode survival rate is 95% or more, and examples 2-3, examples 7-9, examples 11-12, examples 14-17, examples 19-22, and examples 24-32 showed electrode-proof ******** with very good all. Moreover, in the examples 1-2 of a comparison which are typical Pb free solder, an electrode survival rate is 90% or less, and the problem was looked at by electrode-proof ********.

[0032] Although examples 1, 4, 10, and 13 are 77 - 86% of electrode survival rates and are smaller than other examples, this is because there are few additions of an effective element. [of electrode ****** depressor effect] Moreover, although an example 18 also has electrode ****** depressor effect smaller than other examples, this is because soldering temperature is high. Moreover, although examples 5-6 also have the electrode-proof ****** effectiveness smaller than other examples, this is because the electrode ****** depressor effect of Fe is smaller than other elements. However, any presentation is level usable according to soldering conditions.

[0033] Moreover, there was an inclination similar to Cu also in Ag electrode, and also when it was any, as compared with the example of a comparison, the alloying element of this invention had effectiveness in electrode foods crack control.

[0034] About soldering nature, it evaluated using solder expansion ratio (based on JISZ3197). About examples 1-2, an example 4, an example 7, an example 10, examples 13-14, examples 17-19, examples 23-26, and examples 30-32, solder expansion ratio was all 70% or more, and it was very good soldering nature. Moreover, also about the examples 1-3 of a comparison, solder expansion ratio was all 70% or more, and it was very good soldering nature.

[0035] Although solder expansion ratio is falling, this of an example 3, an example 6, an example 9, an example 12, and examples 15-16 is because liquid phase temperature rose since there were many additions of an effective element, and the fluidity of solder was checked. Moreover, although examples 8-9, examples 11-12, examples 21-22, and examples 28-29 show solder expansion ratio lower than other examples, this is for an effective element (Mn, Cr) to tend to oxidize. However, any presentation is level usable according to soldering conditions.

[0036] Moreover, although solder expansion ratio is high if the addition of Sb, Ag, and Cu is increased as shown in an example 18, an example 25, and an example 32, the effect which raised soldering temperature with the rise of liquid phase temperature comes out of this.

[0037]

[Effect of the Invention] Thus, if the soldering goods of this invention are used, while soldering nature is good in the soldered joint section, it is possible to have outstanding electrode-proof ********. Moreover, this electrode-proof ******** cannot remain in electrode ****** at the time of soldering, but can be controlled also about electrode ****** at the time of elevated-temperature neglect of the soldering goods after soldering.

[0038] Moreover, since electrode ****** which has been a technical problem with Pb free solder can be controlled, Pb free-ization of solder becomes more practical and it becomes possible to offer an environment-friendly product.

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TECHNICAL FIELD

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PRIOR ART

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EFFECT OF THE INVENTION

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MEANS

[Means for Solving the Problem] This invention came to complete soldering goods, in order to solve the above-mentioned technical problem. The soldering goods of invention of this application 1st are soldering goods which come to join the components which have the transition metallic conductor which is easy to diffuse to fused Sn with solder. The presentation of said solder At least one kind of 0.01 - 1 % of the weight of Co(es), 0.01 - 0.2 % of the weight of Fe(s), 0.01 - 0.2 % of the weight of Mn, 0.01 - 0.2 % of the weight of Cr(s), and 0.01 - 2 % of the weight of Pd, It is characterized by coming to contain at least one kind and the remaining Sn among 0.5 - 9 % of the weight of Ag, 0.5 - 2 % of the weight of Cu(s), and 0.5 - 5 % of the weight of Sb(s).
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[0010] The addition of Above Co was made into 0.01 - 1 % of the weight in 100 % of the weight of whole because electrode-proof ******** deteriorated when the addition of Co is less than 0.01 % of the weight. It is because liquidus-line temperature rises and a melting property is checked on the other hand, when the addition of Co exceeds 1 % of the weight. In addition, more desirable Co addition is 0.01 - 0.5% of the weight of the range, and its time of especially Co addition being 0.5 % of the weight is desirable.
[0011] The addition of Above Fe was made into 0.01 - 0.2 % of the weight in 100 % of the weight of whole because electrode-proof ******** deteriorated when the addition of Fe is less than 0.01 % of the weight. It is because liquidus-line temperature rises and a melting property is checked on the other hand, when the addition of Fe exceeds 0.2 % of the weight. In addition, more desirable Fe addition is 0.01 - 0.1% of the weight of the range, and its time of especially Fe addition being 0.1 % of the weight is desirable.
[0012] The addition of Above Mn was made into 0.01 - 0.2 % of the weight in 100 % of the weight of whole because electrode-proof ******** deteriorated when the addition of Mn is less than 0.01 % of the weight. It is because liquidus-line temperature rises and a melting property is checked on the other hand, when the addition of Mn exceeds 0.2 % of the weight. In addition, more desirable Mn addition is 0.01 - 0.1% of the weight of the range, and its time of especially Mn addition being 0.1 % of the weight is desirable.
[0013] The addition of Above Cr was made into 0.01 - 0.2 % of the weight in 100 % of the weight of whole weight because electrode-proof ******** deteriorated when the addition of Cr is less than 0.01 % of the weight. It is because liquidus-line temperature rises and a melting property is checked on the other hand, when the addition of Cr exceeds 0.2 % of the weight. In addition, more desirable Cr addition is 0.01 - 0.1% of the weight of the range, and its time of especially Cr addition being 0.1 % of the weight is desirable.

[0014] The addition of Above Pd was made into 0.01 - 2 % of the weight in 100 % of the weight of whole weight because electrode-proof ******** deteriorated when the addition of Pd is less than 0.01 % of the weight. It is because liquidus-line temperature rises and a melting property is checked on the other hand, when the addition of Pd exceeds 2 % of the weight. In addition, more desirable Pd addition is 0.01 - 1% of the weight of the range, and its time of especially Pd addition being 0.5 % of the weight is desirable.

[0015] The addition of Above Ag was carried out among [0.5-9] 100 % of the weight of whole weight because the improvement effect on the strength was small when the addition of Ag is less than 0.5 % of the weight. It is because the bonding strength fall by a superfluous Ag3Sn intermetallic compound depositing when the addition of Ag exceeds 9 % of the weight, and the melting property by solder liquidus-line temperature rising are checked on the other hand.

[0016] When the addition of Cu was less than 0.5 % of the weight, the addition of Above Cu was made into 0.5 - 2 % of the weight in 100 % of the weight of whole weight because the improvement effect on the strength was small. It is because the bonding strength fall by superfluous Cu6Sn5 and a Cu3Sn intermetallic compound depositing when the addition of Cu exceeds 2 % of the weight, and the melting property by solder liquidus-line temperature rising are checked on the other hand.

[0017] When the addition of Sb was less than 0.5 % of the weight, the addition of Above Sb was made into 0.5 - 12 % of the weight in 100 % of the weight of whole weight because the improvement effect on the strength was small. On the other hand, when the addition of Sb exceeds 12 % of the weight, it is because thermal shock nature and workability are checked when elongation falls.

[0018] As a presentation of the transition metallic conductor which is easy to diffuse to fused Sn as used in the field of this invention, the simple substance of Cu, Ag, nickel, Au, Pd, Pt, and Zn etc. is typical. In addition, the alloy of these transition metals, for example, Ag/Pd, Ag/Pt, etc. are sufficient. They are the simple substance of Cu, Ag, and nickel, or its alloy more preferably. Even if it uses for the goods which have such a conductor that is easy to carry out electrode ******, electrode ****** control is attained maintaining soldering nature and bonding strength.

[0019] Although a glass frit and various additives (metallic oxide etc.) are added by the above-mentioned transition metallic conductor if needed, if the metal presentations which are electric conduction components are the above presentations, of course, the same effectiveness is acquired. Moreover, the same effectiveness is acquired, also when low melting point metals, such as Bi and In, are added as a solder presentation in order to lower working temperature.

[0020] Here, in this invention, an unescapable impurity may be included as a solder presentation in addition to the above-mentioned component. The element mixed as an unescapable impurity when manufacturing solder or the element containing from the first, for example, Pb, Bi, Cu, Na, etc., is mentioned.

[0021] After the soldering goods of this invention process the solder made to dissolve the above-mentioned addition component in Sn of a principal component in the shape of a ball, carry a solder ball on components or a substrate and apply flux, they can be easily created by heating to temperature predetermined in the inside of atmospheric air, and joining the conductor of components.

[0022] In addition, although generally soldered in N2 ambient atmosphere in many cases a sake [on a soldering disposition], it is possible to solder in atmospheric air in this invention, since there are few additions of Co, Fe, Mn, Cr, and Pd.

[0023] the components itself to which the soldering goods of this invention are joined, and the conductor of components, although the whole including the soldered joint section which joined comrades electrically and mechanically is meant and there are various gestalten For example, electric in the conductor formed in the element-placement substrate, and the conductor formed in components The thing made to solder in order to make it connect mechanically, the thing which carried out the solder price in order to connect an electronic-parts component and a terminal electrically and mechanically, the thing made to solder in order to connect the electrodes of an electronic-parts component electrically and mechanically are typical.

[0024] As the above-mentioned element-placement substrate, ceramic substrates, such as a printed circuit board made from glass epoxy, a printed circuit board made from a phenol, and an alumina, the substrate which has insulator layers, such as a ceramic, on a metaled front face are mentioned, for example. furthermore, the above - - as a conductor, wiring circuits, such as a printed circuit board, the terminal electrode of electronic parts, a lead terminal, etc. are mentioned.

[0025] Thus, the soldering goods of produced this invention have soldering nature and good bonding strength, and since they have outstanding electrode-proof ********, can set up soldering temperature freely and become the thing excellent in workability. Moreover, it becomes possible to lessen the addition of expensive electrode ****** control elements, such as Ag. Next, although this invention is explained still more concretely based on an example, this invention is not limited only to this example.

[0026]

[Example 1] The solder presentation used by this example is shown in Table 1. In addition, the presentation of the example of a comparison is also collectively shown in Table 1.

[0027]

[Table 1]

[重量%]

	Sn	Pb	Co	Fe	Mn	Cr	Pd	Ag	Cu	Sb
実施例1	94.99		0.01							5.0
実施例2	94.5		0.5							5.0
実施例3	94.0		1.0							5.0
実施例4	94.49			0.01						5.0
実施例5	94.9			0.1						5.0
実施例6	94.8			0.2						5.0
実施例7	94.49				0.01					5.0
実施例8	94.9				0.1					5.0
実施例9	94.8				0.2					5.0
実施例10	94.49					0.01				5.0
実施例11	94.9					0.1				5.0
実施例12	94.8					0.2				5.0
実施例13	94.99						0.01			5.0
実施例14	94.5						0.5			5.0
実施例15	94.0						1.0			5.0
実施例16	93.0						2.0			5.0
実施例17	99.0						0.5			0.5
実施例18	87.5						0.5			12.0
実施例19	96.0		0.5					3.5		
実施例20	96.4			0.1				3.5		
実施例21	96.4				0.1			3.5		
実施例22	96.4					0.1		3.5		
実施例23	99.0						0.5	0.5		
実施例24	96.0						0.5	3.5		
実施例25	90.5						0.5	9.0		
実施例26	98.8		0.5						0.7	
実施例27	99.2			0.1					0.7	
実施例28	99.2				0.1				0.7	
実施例29	99.2					0.1			0.7	
実施例30	98.8						0.5		0.7	
実施例31	99.0						0.5		0.5	
実施例32	97.5						0.5		2.0	
比較例1	95.0									5.0
比較例2	96.5							3.5		
比較例3	99.3								0.7	

[0028] About the solder furthermore shown in Table 1, the evaluation result of electrode-proof ******** at the time of soldering and soldering nature is shown in Table 2.

[0029]

[Table 2]

	半田付け後の電極面積残存率[%]		半田広がり率 [%]	評価温度 [℃]
	Cu電極	Ag電極		
実施例1	85.0	50.0	70	280
実施例2	98.0	60.0	71	280
実施例3	99.6	61.2	65	280
実施例4	77.0	38.0	70	280
実施例5	80.0	40.2	69	280
実施例6	81.0	41.0	63	280
実施例7	99.0	74.2	70	280
実施例8	99.5	80.1	66	280
実施例9	99.4	79.2	60	280
実施例10	86.0	60.2	70	280
実施例11	98.4	63.0	67	280
実施例12	99.0	65.3	62	280
実施例13	82.1	51.6	71	280
実施例14	95.4	63.5	70	280
実施例15	96.3	65.4	69	280
実施例16	97.1	67.8	63	280
実施例17	95.9	53.4	72	280
実施例18	84.1	51.8	78	300
実施例19	99.0	81.0	72	250
実施例20	95.4	76.8	69	250
実施例21	99.2	89.7	64	250
実施例22	99.2	85.0	66	250
実施例23	88.7	79.3	72	260
実施例24	99.7	84.6	72	250
実施例25	99.5	88.1	81	330
実施例26	99.7	52.0	71	260
実施例27	97.0	40.8	69	260
実施例28	99.5	68.9	65	260
実施例29	99.8	58.4	66	260
実施例30	99.6	53.2	72	260
実施例31	99.2	52.3	72	260
実施例32	99.5	50.1	78	330
比較例1	89.2	31.7	72	250
比較例2	7.0	0.0	70	280
比較例3	92.5	0.0	71	260

[0030] Here, the electrode-proof ******** evaluation at the time of soldering measured by the electrostatic-capacity changing method. the veneer capacitor which carried out printing baking of Cu electrode (3 micrometers of thickness), or the Ag electrode (20 micrometers of thickness) -- solder -- being immersed -- the difference of the electrostatic capacity before and behind immersion -- said difference [as opposed to / take a value and / the electrostatic capacity before immersion] -- the survival rate of an electrode was computed in quest of the value. The soldering temperature which evaluated is shown in Table 2. For 10 seconds, since the capacity change after immersion and Ag electrode were easy to be consumed, Cu electrode measured the capacity change after immersion for 3 seconds.

[0031] In any case, in Cu electrode, effectiveness was [the alloying element of this invention] in electrode foods crack control as compared with the example of a comparison. An electrode survival rate is 95% or more, and examples 2-3, examples 7-9, examples 11-12, examples 14-17, examples 19-22, and examples 24-32 showed electrode-proof ******** with very good all. Moreover, in the examples 1-2 of a comparison which are typical Pb free solder, an electrode survival rate is 90% or less, and the problem was looked at by electrode-proof ********.

[0032] Although examples 1, 4, 10, and 13 are 77 - 86% of electrode survival rates and are smaller than other examples, this is because there are few additions of an effective element. [of electrode ****** depressor effect] Moreover, although an example 18 also has electrode ****** depressor effect smaller than other examples, this is because soldering temperature is high. Moreover, although examples 5-6 also have the electrode-proof ****** effectiveness smaller than other examples, this is because the electrode ****** depressor effect of Fe is smaller than other elements. However, any presentation is level usable according to soldering conditions.

[0033] Moreover, there was an inclination similar to Cu also in Ag electrode, and also when it was any, as compared with the example of a comparison, the alloying element of this invention had effectiveness in electrode foods crack control.

[0034] About soldering nature, it evaluated using solder expansion ratio (based on JISZ3197). About examples 1-2, an example 4, an example 7, an example 10, examples 13-14, examples 17-19, examples 23-26, and examples 30-32, solder expansion ratio was all 70% or more, and it was very good soldering nature. Moreover, also about the examples 1-3 of a comparison, solder expansion ratio was all 70% or more, and it was very good soldering nature.

[0035] Although solder expansion ratio is falling, this of an example 3, an example 6, an example 9, an example 12, and examples 15-16 is because liquid phase temperature rose since there were many additions of an effective element, and the fluidity of solder was checked. Moreover, although examples 8-9, examples 11-12, examples 21-22, and examples 28-29 show solder expansion ratio lower than other examples, this is for an effective element (Mn, Cr) to tend to oxidize. However, any presentation is level usable according to soldering conditions.

[0036] Moreover, although solder expansion ratio is high if the addition of Sb, Ag, and Cu is increased as shown in an example 18, an example 25, and an example 32, the effect which raised soldering temperature with the rise of liquid phase temperature comes out of this.

[Translation done.]

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[Title of the Invention] Solder and soldering goods
[Claim(s)]
[Claim 1] Pb [which is characterized by 0.5 - 2 % of the weight of Cu(s), and coming / at least one kind chosen from 0.01 - 1 % of the weight of Co(es), 0.01 - 0.2 % of the weight of Fe(s), 0.01 - 0.2 % of the weight of Mn, 0.01 - 0.2 % of the weight of Cr(s), and 0.01 - 2 % of the weight of Pd, and / to contain 90.5 % of the weight or more of Sn] free solder.
[Claim 2] Pb [which is characterized by at least one kind chosen from 0.01 - 0.2 % of the weight of Mn, 0.01 - 0.2 % of the weight of Cr(s), and 0.01 - 2 % of the weight of Pd, at least one kind chosen from 0.5 - 9 % of the weight of Ag, and 0.5 - 5 % of the weight of Sb(s), and coming to contain 90.5 % of the weight or more of Sn] free solder.
[Claim 3] They are the soldering goods which come to join the components which have the transition metallic conductor which is easy to diffuse to fused Sn with solder,
Said solder is soldering goods characterized by using Pb free solder according to claim 1 or 2.
[Claim 4] Said transition metallic conductors are soldering goods according to claim 3 characterized by using at least one kind in the simple substances of Cu, Ag, nickel, Au, Pd, Pt, and Zn, or those alloys.
[Detailed Description of the Invention]
[0001]

[Field of the Invention] This invention relates to solder and soldering goods.

[0002]

[Description of the Prior Art] Before, solder is used in order to obtain electric and mechanical connection of electronic equipment and electronic parts. The solder (it considers as Pb free solder hereafter.) with which this solder uses as a principal component Sn which does not contain Pb in consideration of earth environment although what used Sn and Pb as the principal component (it considers as Sn-Pb system solder below.) has generally been used, and the remainder consists of Ag, Bi, Cu, In, Sb, etc. is used increasingly.

[0003] By using this Pb free solder in recent years, the soldering goods with which soldering nature has a good electric joint have been manufactured.

[0004]

[Problem(s) to be Solved by the Invention] However, in the soldering goods using the solder whose Sn is a principal component, especially Pb free solder, when electrode ****** happened at the time of soldering or elevated-temperature neglect and heat aging were performed, there was a trouble by diffusion of Sn that degradation of electric and a mechanical property took place.

[0005] The purpose of this invention is to offer Pb free solder and soldering goods which neither electrode ****** nor property degradation can produce easily, when the time of soldering or soldering post heating aging is performed.

[0006]

[Means for Solving the Problem] This invention came to complete Pb free solder and soldering goods, in order to solve the above-mentioned technical problem. Pb free solder of invention of this application 1st is characterized by 0.5 - 2 % of the weight of Cu(s), and coming [at least one kind chosen from 0.01 - 1 % of the weight of Co(es), 0.01 - 0.2 % of the weight of Fe(s) 0.01 - 0.2 % of the weight of Mn, 0.01 - 0.2 % of the weight of Cr(s), and 0.01 - 2 % of the weight of Pd, and] to contain 90.5 % of the weight or more of Sn.

[0007] Moreover, in Pb free solder of invention of this application 2nd, it is characterized by at least one kind of 0.01 - 0.2 % of the weight of Mn, 0.01 - 0.2 % of the weight of Cr(s), and 0.01 - 2 % of the weight of Pd, at least one kind chosen from 0.5 - 9 % of the weight of Ag, and 0.5 - 5 % of the weight of Sb(s), and coming to contain 90.5 % of the weight or more of Sn.

[0008] Moreover, the soldering goods of this invention are soldering goods which come to join the components which have the transition metallic conductor which is easy to diffuse to fused Sn with solder, and solder is characterized by using Pb free solder of the above-mentioned 1st or the 2nd above-mentioned invention.

[0009] Moreover, in the soldering goods of this invention, a transition metallic conductor is characterized by using at least one kind in the simple substances of Cu, Ag, nickel, Au, Pd, Pt, and Zn, or those alloys.

[0010]

[Embodiment of the Invention] The gestalt of operation of this invention is explained below. Pb free solder of invention of this application 1st is the presentation containing at least one kind chosen from Co, Fe, Mn, Cr, and Pd, and Cu and Sn. Moreover, Pb free solder of invention of this application 2nd is the presentation containing at least one kind chosen from Mn, Cr, and Pd, at least one kind chosen from Ag and Sb, and Sn. And the soldering goods of this invention are soldering goods which come to join the components which have the transition metallic conductor which is easy to diffuse to fused Sn with solder, and the 1st mentioned above or Pb free solder of the 2nd invention is used for solder. Such a presentation enables it to offer the soldering goods which have sufficient electrode-proof ********, while soldering nature and bonding strength are good.

[0011] That is, it is for Co, Fe, Mn, Cr, and Pd by which slight amount addition was carried out to form a segregation layer in the junction interface of a conductor and solder, to prevent diffusion into the melting solder of a conductor, and to prevent electrode ******.

[0012] The addition of Above Co was made into 0.01 - 1 % of the weight in 100 % of the weight of whole because electrode-proof ******** deteriorated when the addition of Co is less than 0.01 % of the weight. It is because liquidus-line temperature rises and a melting property is checked on the other hand, when the addition of Co exceeds 1 % of the weight. In addition, more desirable Co addition is 0.01 - 0.5% of the weight of the range, and its time of especially Co addition being 0.5 % of the weight is desirable.

[0013] The addition of Above Fe was made into 0.01 - 0.2 % of the weight in 100 % of the weight of whole because electrode-proof ******** deteriorated when the addition of Fe is less than 0.01 % of the weight. It is because liquidus-line temperature rises and a melting property is checked on the other hand, when the addition of Fe exceeds 0.2 % of the weight. In addition, more desirable Fe addition is 0.01 - 0.1% of the weight of the range, and its time of especially Fe addition being 0.1 % of the weight is desirable.

[0014] The addition of Above Mn was made into 0.01 - 0.2 % of the weight in 100 % of the weight of whole because electrode-proof ******** deteriorated when the addition of Mn is less than 0.01 % of the weight. It is because liquidus-line temperature rises and a melting property is checked on the other hand, when the addition of Mn exceeds 0.2 % of the weight. In addition, more desirable Mn addition is 0.01 - 0.1% of the weight of the range, and its time of especially Mn addition being 0.1 % of the weight is desirable.

[0015] The addition of Above Cr was made into 0.01 - 0.2 % of the weight in 100 % of the weight of whole weight because electrode-proof ******** deteriorated when the addition of Cr is less than 0.01 % of the weight. It is because liquidus-line temperature rises and a melting property is checked on the other hand, when the addition of Cr exceeds 0.2 % of the weight. In addition, more desirable Cr addition is 0.01 - 0.1% of the weight of the range, and its time of especially Cr addition being 0.1 % of the weight is desirable.

[0016] The addition of Above Pd was made into 0.01 - 2 % of the weight in 100 % of the weight of whole weight because electrode-proof ******** deteriorated when the addition of Pd is less than 0.01 % of the weight. It is because liquidus-line temperature rises and a melting property is checked on the other hand, when the addition of Pd exceeds 2 % of the weight. In addition, more desirable Pd addition is 0.01 - 1% of the weight of the range, and its time of especially Pd addition being 0.5 % of the weight is desirable.

[0017] The addition of Above Ag was carried out among [0.5-9] 100 % of the weight of whole weight because the improvement effect on the strength was small when the addition of Ag is less than 0.5 % of the weight. It is because the bonding strength fall by a superfluous Ag3Sn intermetallic compound depositing when the addition of Ag exceeds 9 % of the weight, and the melting property by solder liquidus-line temperature rising are checked on the other hand.

[0018] When the addition of Cu was less than 0.5 % of the weight, the addition of Above Cu was made into 0.5 - 2 % of the weight in 100 % of the weight of whole weight because the improvement effect on the strength was small. It is because the bonding strength fall by superfluous Cu6Sn5 and a Cu3Sn intermetallic compound depositing when the addition of Cu exceeds 2 % of the weight, and the melting property by solder liquidus-line temperature rising are checked on the other hand.

[0019] When the addition of Sb was less than 0.5 % of the weight, the addition of Above Sb was made into 0.5 - 5 % of the weight in 100 % of the weight of whole weight because the improvement effect on the strength was small. On the other hand, when the addition of Sb exceeds 5 % of the weight, it is because thermal shock nature and workability are checked when elongation falls.

[0020] As a presentation of the transition metallic conductor which is easy to diffuse to fused Sn as used in the field of this invention, the simple substance of Cu, Ag, nickel, Au, Pd, Pt, and Zn etc. is typical. In addition, the alloy of these transition metals, for example, Ag/Pd, Ag/Pt, etc. are sufficient. They are the simple substance of Cu, Ag, and nickel, or its alloy more preferably. Even if it uses for the goods which have such a conductor that is easy to carry out electrode ******, electrode ****** control is attained maintaining soldering nature and bonding strength.

[0021] Although a glass frit and various additives (metallic oxide etc.) are added by the above-mentioned transition metallic conductor if needed, if the metal presentations which are electric conduction components are the above presentations, of course, the same effectiveness is acquired. Moreover, the same effectiveness is acquired, also when low melting point metals, such as Bi and In, are added as a solder presentation in order to lower working temperature.

[0022] Here, in this invention, an unescapable impurity may be included as a solder presentation in addition to the above-mentioned component. The element mixed as an unescapable impurity when manufacturing solder or the element containing from the first, for example, Pb, Bi, Cu, Na, etc., is mentioned.

[0023] After the soldering goods of this invention process Pb free solder made to dissolve the above-mentioned addition component in Sn of a principal component in the shape of a ball, carry a solder ball on components or a substrate and apply flux, they can be easily created by heating to temperature predetermined in the inside of atmospheric air, and joining the conductor of components.

[0024] In addition, although generally soldered in N2 ambient atmosphere in many cases a sake [on a soldering disposition], it is possible to solder in atmospheric air in this invention, since there are few additions of Co, Fe, Mn, Cr, and Pd.

[0025] the components itself to which the soldering goods of this invention are joined, and the conductor of components, although the whole including the soldered joint section which joined comrades electrically and mechanically is meant and there are various gestalten For example, electric in the conductor formed in the element-placement substrate, and the conductor formed in components The thing made to solder in order to make it connect mechanically, the thing made to solder in order to connect an electronic-parts component and a terminal electrically and mechanically, the thing made to solder in order to connect the electrodes of an electronic-parts component electrically and mechanically are typical.

[0026] As the above-mentioned element-placement substrate, ceramic substrates, such as a printed circuit board made from glass epoxy, a printed circuit board made from a phenol, and an alumina, the substrate which has insulator layers, such as a ceramic, on a metaled front face are mentioned, for example. furthermore, the above -- as a conductor, wiring circuits, such as a printed circuit board, the terminal electrode of electronic parts, a lead terminal, etc. are mentioned.

[0027] Thus, Pb free solder and soldering goods of this invention which were produced have soldering nature and good bonding strength, and since they have outstanding electrode-proof ********, can set up soldering temperature freely and become the thing excellent in workability. Moreover, it becomes possible to lessen the addition of expensive electrode ****** control elements, such as Ag. Next, although this invention is explained still more concretely based on an example, this invention is not limited only to this example.

[0028]

[Example] The solder presentation used by this example is shown in Table 1. In addition, the presentation of the example of a comparison is also collectively shown in Table 1.

[0029]

[Table 1]

[重量%]

Pb	Co	Fe	Mn	Cr	Pd	Ag	Cu	Sb
			0.01					5.00
			0.10					5.00
			0.20					5.00
				0.01				5.00
				0.10				5.00
				0.20				5.00
					0.01			5.00
					0.05			5.00
					1.00			5.00
					2.00			5.00
					0.50			0.50
			0.10			3.50		
				0.10		3.50		
					0.50	0.50		
					0.50	3.50		
					0.50	9.00		
	0.50						0.70	
		0.10					0.70	
			0.10				0.70	
				0.10			0.70	
					0.50		0.70	
					0.50		0.50	
					0.50		2.00	
								5.00

[0030] About Pb free solder furthermore shown in Table 1, the evaluation result of electrode-proof ******** at the time of soldering and soldering nature is shown in Table 2.

[0031]

[Table 2]

		半田付け後の電極面積残存率 [%]		半田広がり率 [%]	評
		Cu電極	Ag電極		
実施例	1	99.0	74.2	70	
	2	99.5	80.1	66	
	3	99.4	79.2	60	
	4	86.0	60.2	70	
	5	98.4	63.0	67	
	6	99.0	65.3	62	
	7	82.1	51.6	71	
	8	95.4	63.5	70	
	9	96.3	65.4	69	
	10	97.1	67.8	63	
	11	95.9	53.4	72	
	12	99.2	89.7	64	
	13	99.2	85.0	66	
	14	88.7	79.3	72	
	15	99.7	84.6	72	
	16	99.5	88.1	81	
	17	99.7	52.0	71	
	18	97.0	40.8	69	
	19	99.5	68.9	65	
	20	99.8	58.4	66	
	21	99.6	53.2	72	
	22	99.2	52.3	72	
	23	99.5	50.1	78	
比較例	1	7.0	0.0	70	
	2	89.2	31.7	72	
	3	92.5	0.0	71	

[0032] Here, the electrode-proof ******** evaluation at the time of soldering measured by the electrostatic-capacity changing method. the veneer capacitor which carried out printing baking of Cu electrode (3 micrometers of thickness), or the Ag electrode (20 micrometers of thickness) -- solder -- being immersed -- the difference of the electrostatic capacity before and behind immersion -- said difference [as opposed to / take a value and / the electrostatic capacity before immersion] -- the survival rate of an electrode was computed in quest of the value. The soldering temperature which evaluated is shown in Table 2. For 10 seconds, since the capacity change after immersion and Ag electrode were easy to be consumed, Cu electrode measured the capacity change after immersion for 3 seconds.

[0033] In any case, in Cu electrode, effectiveness was [the alloying element of this invention] in electrode foods crack control as compared with the example of a comparison. An electrode survival rate is 95% or more, and examples 1-3, examples 5-6, examples 8-11, examples 12-13, and examples 15-23 showed electrode-proof ******** with very good all. Moreover, in the examples 1-2 of a comparison which are typical Pb free solder, an electrode survival rate is 90% or less, and the problem was looked at by electrode-proof ********.

[0034] Although examples 4 and 7 are 77 - 86% of electrode survival rates and are smaller than other examples, this is because there are few additions of an effective element. [of electrode ****** depressor effect] However, any presentation is level usable according to soldering conditions.

[0035] Moreover, there was an inclination similar to Cu also in Ag electrode, and also when it was any, as compared with the example of a comparison, the alloying element of this invention had effectiveness in electrode foods crack control.

[0036] About soldering nature, it evaluated using solder expansion ratio (based on JISZ3197). About an example 1, an example 4, examples 7-8, an example 11, examples 14-17, and examples 21-23, solder expansion ratio was all 70% or more, and it was very good soldering nature. Moreover, also about the examples 1-3 of a comparison, solder expansion ratio was all 70% or more, and it was very good soldering nature.

[0037] Although solder expansion ratio is falling, this of an example 3, an example 6, and examples 9-10 is because liquid phase temperature rose since there were many additions of an effective element, and the fluidity of solder was checked. Moreover, although examples 2-3, examples 5-6, examples 12-13, and examples 19-20 show solder expansion ratio lower than other examples, this is for an effective element (Mn, Cr) to tend to oxidize. However, any presentation is level usable according to soldering conditions.

[0038] Moreover, although solder expansion ratio is high if the addition of Sb, Ag, and Cu is increased as shown in an example 16 and an example 23, the effect which raised soldering temperature with the rise of liquid phase temperature comes out of this.

[0039]

[Effect of the Invention] Thus, if the soldering goods of this invention are used, while soldering nature is good in the soldered joint section, it is possible to have outstanding electrode-proof ********. Moreover, this electrode-proof ******** cannot remain in electrode ****** at the time of soldering, but can be controlled also about electrode ****** at the time of elevated-temperature neglect of the soldering goods after soldering.